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PROGRESS IN SANITATION[1]

By Professor EDWARD BARTOW

STATE UNIVERSITY OF IOWA

WHEN the title of this address was sent to the secretary, the plan was to describe the progress in sanitation for the past thirty years, that is from about 1906, when *Chemical Abstracts* was started and when "Standard Methods of Water Analysis" was first published by the American Public Health Association. Then it was decided to discuss the progress of water chemistry for about seventy years, that is, from the time when Wanklyn published the first edition of his "Water Analysis."

Again the plan was changed, because of a visit to the German Industrial Museum at Munich, the discovery of a book on "Water," written in 1757 and because of a statement attributed to a president of the American Mathematical Society. He said that mathematics is *the science,* while all other sciences are merely divisions of mathematics. For example, physics is the noisy part, zoology the messy part and chemistry the smelly part.

I do not propose, as might be expected from this introduction, to try to prove that chemistry is *the science,* and that all other sciences are mere branches. Quite the contrary, I wish to show that chemistry helps the other sciences, that chemistry is dependent on other sciences in the building of what we might call the house of chemistry and that it is the service science.

The house of chemistry, or perhaps we should call it the mansion, castle or palace of chemistry, can not exist alone. Can we not imagine that it is built on the rocks of geology and mineralogy? Indeed, the alchemists looked for the philosopher's stone and attempted to turn the baser metals into gold. This mansion is built in the garden of agriculture. Its foundation is in the healing art of medicine, for the alchemists and the early chemists sought for the elixir of life, and at all times medicine has been an incentive to chemical re-

[1] Address of the president of the American Chemical Society, Pittsburgh, September 9, 1936.

search. Mathematics is a flight of steps leading to higher places where calculations may be proven correct by chemical experimentation. Physics is the windows, where physical instruments shed light on the intricacies of the composition of matter and the changes which chemistry may cause it to undergo. Astronomy is the upper story, from which chemistry looks out on the universe and studies the composition of the stars. History is the walls, which bind the various parts together and include chemistry and the sciences in one homogeneous system.

Chemistry in its turn serves the other sciences and other divisions of learning. It has sometimes been said that chemistry serves all the colleges in a university, except law, fine arts and theology. Yet, even these, while there may be no direct connection, are served indirectly. In law, the lawyer, in certain criminal trials involving cases of poisoning, must call on the chemist to teach him the chemistry of such cases. It is easier to develop a patent lawyer to deal with chemical patents from a chemist than from a graduate in law.

In fine arts, the artist must rely on the chemist to obtain fast colors for his paintings, the sculptor must look to the chemist to be assured of the lasting quality of the stone or metal, which he uses in his art.

Every science must call on the chemist for help. Geology and mineralogy ask for the composition of the rocks, of oils and of natural waters. Medicine calls for preservatives, anesthetics, antiseptics and healing drugs. The early Egyptians had a knowledge of preservatives when they wrapped the dead in cloth and chemicals. What a help to the physician has been the discoveries of nitrous oxide, ether, chloroform and other anesthetics.

The physicist discovers a new phenomenon, and comes to the chemist for an explanation. The arrangements of the atoms in the molecules and the composition of the molecules explain the physical phenomena, and the physical phenomena explain the variation in chemical composition.

The history of nations is deeply affected by chemical discovery. Gunpowder, synthetic ammonia and poison gas are notable examples.

The mansion of chemistry has many rooms. The relations of the members of the chemical family are so close that the rooms are often shared and there is frequent exchange of visits. It is difficult to assign definite rooms to the various members. Let us again imagine that the lower floors are assigned to the older and fundamental branches of chemistry. Inorganic is the older and should be near the entrance, and then will come analytical organic and physical, with the applied branches on the upper floors. Biochemistry, sanitary chemistry, industrial chemistry and chemical engineering are located there and are all dependent on the group on the lower floors.

It is impossible to dwell in detail on all the members of the family. I am planning to go into more detail concerning the member known as water, sewage and sanitation, and especially that space that deals with water. The most important information regarding water since history began is the knowledge of its content. Precautions have always been taken to make certain that it was satisfactory for its intended use. This fact is admirably brought out by the exhibit in the Industrial Museum at Munich.

Beginning with natural springs such as were used in ancient times, various types of water supply are illustrated in the museum. These include a simple well of the Egyptians, the cisterns of the Greeks, the great aqueducts of the Romans down to a model of one of the extensive water purification plants of the present day.

Our water purification plants often have models of their buildings and equipment at the plant to show visitors how the water is treated. There should be such exhibits in every plant and also in some public place, such as the city hall or a museum.

Recently, with two friends, I visited the water purification plant in their home city. While they had lived in the city for many years, they knew in general that the water was purified, but they had never visited the plant, and did not know how to reach it. They were astonished at the equipment required, the careful control of the chemical and bacterial condition of the water and the automatic devices that were used to give a pure and wholesome water. I hope that many of my hearers, if they have not already visited the water purification plant in their home city, will take an opportunity to do so. I can guarantee that they will be welcomed by the superintendent or the chemist, and they will be pleased with such a visit.

Most of us do not realize how greatly conditions have changed. It was formerly necessary to carry the water from the well or the fountain in the street. Now we receive a bill for 30 cents per 1,000 gallons, which pays for the delivery of seven and one half tons of water to our faucets.

Modern water analysis and water purification are of comparatively recent origin. Wanklyn, in England, wrote the first edition of his book on "Water Analysis" in 1868. His work was entirely chemical. He endeavored to use the amount of ammonia formed by distilling a water with an alkali and potassium permanganate as the index of pollution. The method was arbitrary. Many of the tests Wanklyn describes are in use to-day.

The first edition of Mason's "Water Analysis" was

published in 1899. It was the pioneer and for many years the standard in this country.

Bacteriological methods were introduced at a later date. As an index of pollution they are better than the chemical tests. The test for *Bacillus coli* is the best index. It does not indicate infection, but does show the presence of fecal matter and the past, present or future presence of possible infection.

The claim of Wanklyn is not justified, when he states in the preface to his first edition of "Water Analysis, A Practical Treatise on the Examination of Potable Water," "We believe that this is the first book which has been published on Water Analysis." John Rutty, M.D., published in 1757, over one hundred years before, a book with a title page very comprehensive in its claims.

A
METHODICAL SYNOPSIS
OF
MINERAL WATERS

Comprehending
The most celebrated Medicinal
Waters

Both COLD and HOT
Of Great-Britain, Ireland, France, Germany
Italy, and several other parts of the World

Wherein

Their several impregnating Minerals being previously described, and their Characteristics investigated, each water is reduced to its proper Genus, and beside the particular Analysis, the Virtues, Uses, and Abuses of the Water are described,

IN A METHOD ENTIRELY NEW
INTERSPERSED WITH TABLES

Tending to throw a Light on this intricate Subject;

AND

Abstracts of the principal Authors who have treated of Mineral Waters; and the Accounts dispersed in the Acts of the most learned Societies in Europe, are collected and properly digested.

By JOHN RUTTY M.D.

LONDON:

Printed for William Johnston at the Golden Ball in St. Paul's Church-Yard.

MDCCLVII

The book is dedicated to Dr. Peter Shaw, Dr. Stephen Hales and Dr. Thomas Short, as competent judges of his work. Rutty refers to the work of Shaw and Short, and I have found[2] that Dr. Short wrote a book on "Water Analysis" in 1733. This antedates Rutty's book.

Rutty's book was written before the separation of water into the elements hydrogen and oxygen, as shown by his statement: "Although we know of no water absolutely pure or free from all admixture of saline or terrestrial matter, yet many springs contain so exceedingly small a quantity of these, that it is in a manner inconsiderable, and make the nearest approach to pure element." Or again, "It abundantly appears by these tables that none of these waters are pure element, but all contain some pittance, more or less, of earth, marine salt, calcareous nitre and sulphur."

The phlogiston theory was still dominant. He describes the preparation and use of lime water by saying that "the particles of fire united to the stone, being analogous to that of an acid, there is an exchange between the lime with its acid, (fire), on the one hand, and of the earth and its acid on the other hand, and the formation of a cloud, sediment or crust."

It is often stated that cities are located where there is a satisfactory and abundant water supply. This is not a new idea, for Rutty in 1757 wrote, "It is of great importance in building a town to choose a proper situation with regard to the quality of springs."

He also states: "The sacred records, (2 Kings ii, 19) mention a city, the situation of which was pleasant, but the springs naught, and the land barren; which waters were not amended, except at the expense of a miracle tho' it is observable, that this was not wrought without means, viz., by salt put in a new cruse, and cast into the spring of the waters by the prophet, whereby they were healed."

Rutty compares this procedure with the use of ashes for softening water in his day, nearly two hundred years ago.

Rutty carried out experiments on the hard waters about the city of Dublin, and as a matter of history states: "The brackishness of the springs of Dublin is a matter of very ancient observation: for Hanmer, in his Chronicles of Ireland informs us that when St. Patrick (who landed in Ireland A. D. 432) came to Dublin, the inhabitants complained that they were annoyed with brackish waters, which they were of necessity driven to drink, but that he walking about the (then) village turned up the clods and digged the earth and found a well, which has since been called St. Patrick's well; and indeed a fine spring of this denomination was well known and esteemed for many years, tho' lately lost."

The fact that they were *driven to drink water* reminds me of the plight of a man in one of the cities of Illinois, who wrote in great haste to the State Water Survey for a bottle for the collection of samples of water, because the city had voted *dry*, and

[2] R. Watson, "Chemical Essays," London, 1789.

until they had the water analyzed they would have nothing to drink.

Also of the Bishop of Springfield, Ill., who, before they had the filter plant, visiting the laboratory of the Water Survey with some of his fellow clergymen, called them to see a sample of Springfield water with the remark, "See what we have to bathe in in Springfield."

In his discussion of snow water, Rutty says: "A vulgar prejudice has prevailed thro' a series of ages, being supported by no less an authority than the Father of Physic, against the use of snow-water, as hard, rough and unwholesome: and the bronchocele (goiter) of the inhabitants of the Alps has been generally charged to the use of snow waters: but a more accurate search into the nature of waters, and the discovery of their distinguishing impregnating parts reserved for these later ages, together with observations from experience with the use of snow waters have shown the groundlessness of these traditions, and now almost established the credit of snow water as the purest of all others. . . . Bronchocele does not occur in Greenland where snow water is used, and does occur in certain mountainous parts of Africa where brook water is used." The recent discovery that goiter is due to the lack of iodine confirms Rutty's conclusion that the snow water in itself was not the cause of goiter, but that lack of iodine was.

Rutty made and reported analyses of 309 springs in England, Ireland (his own country), where he practised medicine for thirty years, during which time he took every opportunity of examining all mineral waters he could procure, and compare them with the published data on waters from all over Europe.

The tests correspond to some made to the present day. He determined the quantity of contents in a gallon, and its quality, the action with soap, solution of silver, solution of lead, solution of alum, lime water, acids and flesh. One of the most interesting, a forerunner of the alkalinity and of the pH test by indicators, was a comparison of the hard and soft waters as follows: "The syrup of violets gives a deeper green, and more quickly to the hard waters, as do also galls and sumach, and logwood a deeper red, even approaching to crimson and purple in several of the hard water more than in the soft, rhubarb also gives a deeper amber, and ash-bark a deeper blue to the hard waters, *viz.* from the greater quantity of calcareous nitre and earth. And all these appearances are perfectly agreeable to the respective accounts of the greater quantities of the saline and terrestrial contents in the hard and soft waters." Other examples of the work described by Rutty might be given, but these should suffice to show the information concerning the quality of water known nearly two hundred years ago.

Now consider some of the improvements in sanitation made in recent years. Prior to 1910 the typhoid fever death rate was 20 to 25 per 100,000. Since 1915 it has been 1.3 to 2.2 or less. In 1893 the rate in Chicago was 170 per 100,000. For years, it has been less than 1.0. By the destruction of the mosquito and its larvae in water, malaria has been eliminated. Cholera is a disease of the past.

There has been improvement in water for domestic use, the improvement in water for industrial uses, including water for boilers, and in the protection of water supplies by sewage disposal.

(1) Water for domestic use was first treated on a large scale in the so-called slow sand filters. In the latter part of the last century, rapid filters were invented. There was a controversy concerning their merits. The controversy was practically settled, when it was found that slow sand filters could not be used with very turbid water, and with the introduction of sterilization of the water by bleaching powder or liquid chlorine. The rapid filters are now more generally used.

Methods of water purification have been improved. The great settling basins formerly used, which had to be cleaned by the removal of all water and digging or flushing out of the sediment, have been superseded by basins containing mechanical rakes for the continuous removal of the sediment. The layer of slime on top of the slow sand filters has been replaced by a layer of hydroxide of aluminum or iron, which in many cases is sterilized and is frequently removed. Sterilization of water by bleaching powder was first used at Boonton, New Jersey, and at the Union Stock Yards in Chicago. Liquid chlorine, which is gasified before it enters the water, has given even greater satisfaction so that practically no bleaching powder is used at the present time. The cost of chlorine, also, has dropped from fifteen cents in 50-pound containers to two cents in one-ton containers. Additions of ammonia or one of its salts gives chloramine, more effective than chlorine.

Chemical and bacteriological control of water, exercised by the National Institute of Health, in interstate commerce, by the State Boards of Health in each state and by laboratories at each water purification plant, insure pure water.

(2) Industry demands good water, usually a soft water for industrial processes, especially for the production of power. No large textile centers have grown up in the hard-water territory of the upper Mississippi valley.

Power plants, especially as boiler pressures have increased, have demanded better and better water. About thirty years ago, the chief chemist of the Santa Fe Railroad told me that he hoped to soften all waters on the system that had a hardness of more

than 10 grains per gallon (170 parts per million). Now efforts are made to have all waters with hardness as near zero as possible. In some cases distilled water is used.

As an example of the effort to procure the proper water in one power plant, Mississippi River water is first treated with lime and alum to remove suspended matter and partially soften; the excess of lime is neutralized with sulfuric acid; the water is passed through a base exchange softener to reduce the hardness to zero, and it is finally distilled to remove all mineral matter.

It is only since 1912, when Ganz announced his discovery, that the base exchange process of water softening has been known. The base exchange mineral takes calcium from the water, to which it gives up sodium. The mineral is regenerated by treatment with a solution of common salt, which gives up its sodium and takes the calcium out of the mineral. The regeneration of the mineral can be continued indefinitely.

The base exchange softeners came into use slowly, in the home at first, but to-day they are in use in laundries, textile mills and power plants. The discovery of the base exchange process was really revolutionary in its effect on the process of water softening.

The electro-osmose process, developed by Siemens and Halske, in Germany, furnishes a water, in most respects, equal to distilled water. In some respects it is superior. By a series of three-compartment electrolytic cells, the positive and negative ions are removed. Silica and non-electrolytes are not removed.

The process has been used to a considerable extent in Germany and France, but very little in this country. The first installation was not successful, because an attempt was made to treat a water high in chlorides. So much chlorine was set free that it destroyed the canvas diaphragms of the cells. It is hoped that future trials will be made in the United States. We have tested one of the machines in our laboratory and have found it efficient, producing a better product at less expense than distillation.

We recently saw one of the machines in use at the Agricultural Experiment Station of the Kali Syndicate, near Berlin, Germany. The machine gave a water free from electrolyte, including ammonia, needed for tests being made on the efficiency of fertilizers.

The latest method of water treatment, of which I have any knowledge, was demonstrated at the recent World Chemical Engineering Congress in London, England. The Chemical Research Laboratory of the Department of Scientific and Industrial Research at Teddington exhibited condensation products with absorption properties, prepared from formaldehyde, with polyhydric phenols and amines. One kind removes anions, and the other kind removes cations, giving a water free from electrolytes. The process is comparable with distillation and the electro-osmose process.

(3) Closely related to water supply is sewage disposal. Historically, we have, first, disposal on the land, next, construction of sewers and disposal in the streams, and the various methods of purification as the streams were unable to carry the load of sewage from large cities.

Sewage farms, one of the first methods of sewage disposal, were used by Berlin, Paris and other large cities. In Berlin, when the farms were first established, the city attempted to sell the vegetables grown on these farms. Sewage farm vegetables could not be sold. The city then leased the farms to peasants, and peasant-grown vegetables readily sold in Berlin markets. There is a limit to the amount of sewage that can be handled on land, and a limit to the amount of land available near large cities. Therefore, various methods requiring less space for disposal have been developed. Sand beds require less area. Still less is required by filters of various types in which the sewage is sprayed over beds of stone or cinders in such a manner that air is carried into the interstices of the stones or cinders, to destroy the organic matter by aerobic bacteria. Settling tanks and the so-called septic tanks are used alone or supplementing other methods. In the septic tanks decomposition takes place without air. Various methods of aeration have been developed, including slate beds, through which sewage passes, and into which air is blown. This scheme led to the activated sludge process of Ardern and Lockett.

By blowing air into sewage a sludge rich in aerobic bacteria is developed. The sludge, when mixed with incoming raw sewage and stirred with air, accomplishes the purification very rapidly. The process has been so successful that many large cities, including Indianapolis, Milwaukee and Chicago, have adopted it.

In some states, notably Illinois, it is impossible to forbid the fouling of streams by sewage, on the ground that water supplies will be polluted and that human beings will be injured. It is possible, however, to prevent the dumping of an excess of sewage or industrial wastes into Illinois streams, if it can be shown to be detrimental to fish life.

An injunction against the Sanitary District of Chicago and the Corn Products Refining Company was threatened by the Illinois Rivers and Lakes Commission. The waste from the factory was proven equivalent to the sewage from a city of 380,000 people. The wastes could not be economically treated as

sewage, but it was possible to use the waste within the plant in such a way that the load was reduced from the equivalent of 380,000 to 10,000 people. This was done with profit to the company. To-day practically all corn products factories in the country are "bottled up."

Cities located on sea-coasts might dispose of sewage by dilution in the ocean without injury to drinking water supplies. Where the outlets are near seaside resorts, the wastes pollute the beaches, and these cities are being compelled to treat their sewage. At present New York City is constructing an immense sewage disposal plant to prevent the pollution of the Hudson River and the water of the beaches of the Long Island and New Jersey coasts. Lake cities have the same serious problem, but augmented by the fact that often it is necessary to obtain water supplies from the lakes into which sewage must be dumped. As a result, disposal is further advanced in the lake states than in the coastal states.

Cities on large streams like the Ohio, Missouri and Mississippi Rivers have so much dilution that the oxygen dissolved in the water serves to destroy the organic matter and bacteria of the sewage, and there is less need for treatment. Minneapolis and St. Paul have a Sanitary District to treat the sewage which will have its organic matter so reduced that the upper Mississippi will be able to oxidize it and eliminate any nuisance to the cities down stream.

Conclusion

We have told of what has been done in past years. What of the future? About 25 years ago, I heard the statement that a certain organization 25 years before had done all that need be done, and it was only necessary to adopt their findings. Even to-day, I am not willing to say that any branch of water, sewage and sanitation is perfect. We know what a pure drinking water is and we know how to procure it. The water chemist in the future will develop still better methods, better control and a more economical procedure. We may find new coagulants or new and better sterilizing media. For example, if ozone can be made more cheaply and if a metal or other conductor can be found that will withstand corrosion, ozone might well replace chlorine, which is so universally used to-day. Ultra-violet light and the catodyn (silver) process are on trial.

Better methods of treatment of water for industry will be found. We have seen the Clark process, lime, widely used. The base exchange process is practical for use in industry, though it is not used in many municipal plants. The electro-osmose is being more used, and I am told that the new process being developed at Teddington, England, may be placed on a practical basis and that we may have a development in water treatment that will be comparable to the previous advance made by the base exchange.

I think great progress will be made in the disposal of sewage and trade wastes, resulting in the better protection of our streams. A way will be found to conserve the values that are now being wasted. Trade-wastes are of special interest. The nitrogenous and other wastes of the organic chemical industries may furnish compounds which some day may be of future value.

SCIENTIFIC EVENTS

MEDICAL FELLOWSHIPS IN ENGLAND

THE London *Times* states that the Medical Research Council has decided to institute a series of studentships and fellowships to encourage young British medical graduates of special ability and original mind towards becoming investigators in those branches of medical science which are concerned directly with disease as it occurs in human beings. This field of research includes investigations into disease or manifestations of disease in patients, together with experimental work of an immediately relevant kind.

Six post-graduate studentships are therefore offered for medical graduates who have already held house appointments and are strongly inclined to a career in clinical science or experimental pathology. Each selected student will receive an inclusive grant at the rate of £200 a year, during a period not exceeding twelve months, for personal maintenance while undertaking approved courses of study in England such as may be regarded as best calculated to advance the student's training in methods of research. This study may include modern languages and such advanced physiological, pathological and special clinical work under recognized teachers as may be regarded as forming a suitable preliminary to serious research work to be undertaken later; but the approved course may not include studies of which the purpose is to enable the student to pass further examinations.

The council also offers four research fellowships for candidates of similar qualifications who have already had some experience in the use of research methods. Each fellowship will be tenable for one year at the value of £250 a year, and will be renewable in approved instances at the rate of £300 a year for a second year. These fellowships are intended as probationary appointments for research in clinical science

or experimental pathology under suitable direction in England. Research expenses will be provided in addition to stipend.

EXTENSION OF THE WORK OF THE U. S. WEATHER BUREAU

UNDER a special research grant provided from funds available under the Bankhead-Jones Act, an investigation of the structure of polar continental air and the development of cold waves in North America will be undertaken by the Weather Bureau. This will include twice-daily airplane observations at Fairbanks, Alaska, from September 15, 1936, to March 14, 1937. In addition, there will be made at Fairbanks, Alaska, and Fargo, N. Dak., detailed terrestrial radiation measurements. The Canadian Meteorological Service is endeavoring to establish an airplane observation station during the same period at Fort Smith, Northwest Territory, Canada, in the Mackenzie River Basin. The latter observations will considerably enhance the value of the project.

An increase in appropriations for the current fiscal year makes possible an extension of the fire-weather service of the Weather Bureau, mostly in western districts. It is contemplated that new fire-weather trucks will be purchased for mobile forecasting units similar to the one which has been used in California since 1929. The trucks are to be equipped with radio receivers and transmitters, meteorological instruments, charting facilities, camping equipment, etc. Two men, a forecaster and a radio operator, will travel with each truck to the site of large-going forest fires, where they will set up the equipment and prepare weather maps from signals and reports received by radio and over Forest Service telephone lines. Detailed forecasts and warnings are issued from this truck unit for the immediate use of forestry officials in charge of fire-fighting crews. The new truck units will be stationed, respectively, at Missoula, Mont., serving Idaho and Montana, and at Portland, Ore., serving Oregon, except the extreme southwest portion, and at Mount Shasta, Calif., serving northern California and a section of southwestern Oregon. First order stations of the Weather Bureau, for fire-weather purposes only, are being opened at Pasadena and Mount Shasta, Calif.

S. D. F.

THE ARMY MEDICAL LIBRARY

AT the thirty-eighth annual meeting of the Medical Library Association the following resolutions were adopted recommending the appropriation of adequate funds for the maintenance and growth of the Army Medical Library's Book Collection and Index-catalogue.

The Medical Library Association, comprising two hundred of the medical libraries of the United States and Canada, assembled in its thirty-eighth annual session in St. Paul, June 22, 1936, notes with pleasure and pride the appearance of volume one of the fourth series of the "Index-catalogue" of the Library of the Surgeon-General's Office, United States Army (Army Medical Library). The association records with satisfaction the abbreviations and changes in composition in this new volume effecting a saving of twenty per cent. in space with accompanying reduction in cost.

After a delay of three years during which no volumes of this catalogue were printed, the appearance of this first volume of the fourth series gives renewed assurance of the continuation of this publication, which, together with the Army Medical Library, is considered the outstanding contribution which our country and its government have made to medical knowledge, and,

WHEREAS, The value and usefulness of the "Index-catalogue" is dependent upon the completeness of the files of medical publications contained in the Library of the Surgeon-General's Office—a public, national, medical library, the greatest in the world, serving in its present form of administration with satisfaction the medical profession and the medical libraries of our country, and,

WHEREAS, In recent years the annual appropriation of the Congress has been wholly inadequate to provide sufficient funds to acquire the current medical books and periodicals issued throughout the world, so that they might be available for use throughout the country and for inclusion in the "Index-catalogue;" therefore, be it

Resolved, That the Medical Library Association urges the Congress to appropriate annually to the Library of the Surgeon-General's Office an adequate sum for current medical books and periodicals and for the purchase of back publications lost during those recent years when the amount granted was grossly inadequate, thus depreciating the completeness and usefulness of the library's collection; and an additional sufficient sum annually, for as many years as may be required, in order to make for the greatest possible completeness of the collection and its catalogue; and, be it further

Resolved, That a sum be appropriated annually to defray the cost of printing regularly each year not less than one volume of the "Index-catalogue;" and, be it further

Resolved, That a copy of these resolutions be spread upon the minutes of the annual meeting of this association and sent to the President of the United States, the presiding officer of both houses of Congress, the Secretary of War, the Surgeon-General of the Army, and to the national, state and other medical periodicals with a request for publication, and to the members of this association, urging the organization of which they are a part and all other medical associations and institutions to adopt similar resolutions to be sent to their local members of Congress requesting their support of these measures.

THE DENTAL CLINIC OF THE UNIVERSITY OF CHICAGO

SEEKING to bridge the gap between medical and dental research, the University of Chicago this month will open its new Zoller Memorial Dental Clinic, as a division of the University Clinics. The project is made possible through a fund bequeathed to the university by the late Walter G. Zoller, a Chicago coal magnate who died in 1933, which now amounts to $2,900,000.

The Zoller Clinic will represent the most concrete recognition yet made of the close relation between the condition of the mouth and that of the rest of the body. It will have the three-fold purpose of prosecuting research, providing advanced training for young dentists and giving dental service to a selected group of indigent patients. Initially, the patients will be drawn from among charity patients in the University Clinics or its affiliates, notably from the Home for Destitute Crippled Children, the Country Home for Convalescent Children and the Bobs Roberts pediatric hospital.

A selected group of dental graduates will be added to the staff as internes, fellows and instructors. Part of their time will be occupied with giving dental service, part in study and research in the university's basic departments of biological science. Working through such departments as bacteriology, physiology, biochemistry, pathology, anatomy and embryology, this group will engage in research on problems relating these fields with dentistry. Degrees granted will be the regular academic awards made through those departments, such as master of science or doctor of philosophy.

Dr. James R. Blayney, formerly professor of dental pathology and therapeutics at the University of Illinois, who is director of the Zoller Clinic, points out that "Never before has there been such an opportunity to integrate the oral diseases with the systemic diseases. In the study of dental conditions the research worker can reach the frontiers of the unknown more quickly than in any other field of medical research." Despite the fact that 98 per cent. of modern men are affected by disorders of the teeth and mouth, the cause of dental caries, or tooth decay, the commonest ailment, is largely unknown. Neither is it known why tooth decay occurs so frequently during adolescence.

Dr. Arthur C. Bachmeyer, director of the University Clinics, commenting on the "unfortunate hiatus that has existed between medicine and dentistry," states that the Zoller dental project will be started on a modest scale. Eventually, however, its budget will be $80,000 a year. The clinic will be housed in quarters adjoining the Frank Billings Library in the University Clinics. The late Dr. Billings is credited with the discovery that teeth can be centers of focal infection.

CORRESPONDENT

THE AMERICAN FISHERIES SOCIETY AND THE COUNCIL ON FISHERY INVESTIGATIONS

THE sixty-sixth annual meeting of the American Fisheries Society was held in Grand Rapids, Michigan, on September 2, 3 and 4, with about 360 members and guests in attendance.

As is the usual custom, this meeting was held during the same week as that of the International Association of Game, Fish and Conservation Commissioners. The meeting of the American Fisheries Society followed the commissioners' meeting, with joint sessions of both organizations on September 2 that were devoted to a field trip and the joint annual banquet at the Pantlind Hotel. Under the supervision of the president, Frank T. Bell, U. S. Commissioner of Fisheries, and the secretary, Seth Gordon, a program of some fifty-six papers was arranged.

Following the presentation of reports of officers and committees, management of the lake fisheries occupied the attention of the association including the presentation of fourteen papers followed by research developments including fifteen papers. Creel census and tagging studies, disease parasites and predators, breeding and food habit studies, and a miscellaneous section were included on the program. Owing to the crowded program a night session was held to complete Thursday's program at which was presented as an added feature two motion picture films that were shown for the first time. One of these depicted the cooperative Great Lakes fishery investigations of the state of Michigan and the U. S. Bureau of Fisheries; the other was a preliminary showing of an unfinished film of four reels prepared by Arthur H. Fisher for the Bureau of Fisheries, showing the natural history of trout.

The following were elected officers for the coming year: *President,* Dr. A. G. Huntsman; *First Vice-president,* I. T. Quinn; *Second Vice-president,* Fred J. Foster; *Secretary-Treasurer,* Seth Gordon; *Librarian,* Kenneth Cobb. Division vice-presidents for the coming year are Arthur Aldrich, fish culture; Dr. M. M. Ellis, aquatic biology and physics; M. C. James, commercial fishing; William C. Tucker, protection and legislation, and Kenneth Reid, angling. The next meeting of the association will be held from August 23 to 25, 1937, in Mexico City, Mexico.

The twenty-third meeting of the North American Council on Fishery Investigations was held in New

York from September 23 to 25 at the American Museum of Natural History. The council is an official technical advisory board representing the countries of France, Newfoundland, Canada and the United States established in 1921 for the purpose of coordinating fishery investigations by the various countries in the North Atlantic region where nationals of all the countries concerned are engaged in the extensive commercial fisheries.

Owing to the resignation of Dr. Harold Thompson as director of fishery investigations in Newfoundland to undertake the direction of similar work in Australia, that country was not represented, nor was Dr. Edouard le Danois, the French delegate, able to attend. Full delegations from Canada and the United States, however, were present, including Dr. Henry B. Bigelow, chairman of the council; Frank T. Bell and Elmer Higgins, of the Bureau of Fisheries; Wm. A. Found, Deputy Minister of Fisheries, Canada; Dr. A. G. Huntsman, secretary of the council, and Dr. J. P. McMurrich, of the Biological Board of Canada. R. H. Fiedler, chief of the Division of Fishery Industries, and I. E. Sette, Wm. C. Herrington and John R. Webster, of the staff of the North Atlantic Fishery Investigations of the Bureau, also attended as technical advisers, together with a corresponding group from Canada. The next meeting of the council will be held early in September, 1937, in some Canadian city to be chosen at a later date.

RECENT DEATHS

DR. JUSTUS WATSON FOLSOM, entomologist of the Louisiana Station of the Division of Cotton Insect Investigations, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, at Tallulah, and previously for about twenty-five years a member of the faculty of the University of Illinois, died on September 24 at the age of sixty-five years.

DR. SAMUEL MONTGOMERY KINTNER, vice-president in charge of engineering of the Westinghouse Electric and Manufacturing Company, formerly professor of electrical engineering at the University of Pittsburgh, known for his work on radio communications and broadcasting, died on September 28 at the age of sixty-four years.

DR. GEORGE A. MACCALLUM died on September 30 at the age of ninety-three years. Dr. MacCallum, who was the father of Dr. William G. MacCallum, professor of pathology and bacteriology at the Johns Hopkins University, was born and for many years practised medicine in Canada. Later, as a student of parasitology, he was connected with the New York Zoological Park, the Aquarium and the American Museum of Natural History.

Nature records the death on August 18 of Dr. W. H. Harrison, formerly Imperial agricultural research chemist for the Government of India, lately acting agricultural adviser, aged fifty-nine years.

DR. F. J. F. SHAW, director of the Agricultural Research Institute at Pusa, India, officiating as agricultural expert to the Imperial Council of Agricultural Research, died on July 29.

DR. ROBERT STIRTON THORNTON, an organizer of the Canadian Medical Association, formerly minister of education for Manitoba, died on September 18 at the age of seventy-three years. Dr. Thornton served in the Manitoba Legislature as a liberal member for eleven years, seven with a minister's portfolio.

SCIENTIFIC NOTES AND NEWS

AT the forty-first annual convention of the American Academy of Ophthalmology and Otolaryngology, in session in New York City last week, the Lucien Howe Medal "for outstanding achievement in ophthalmology" was presented to Sir John Herbert Parsons, London.

AN honorary doctorate has been conferred by the University of London on Dr. Max Planck, professor of physics at the University of Berlin, president of the Kaiser Wilhelm Society for the Advancement of Science.

Nature reports that Sir Arthur Smith Woodward, Sir Charles Sherrington, M. Ruzicka and M. Bottazzi have been elected associates of the Royal Academy of Belgium. Professor F. van den Branden, professor of clinical urology in the University of Brussels, and Professor H. Fredericq, professor of zoology in the University of Liège, have been elected correspondents of the academy.

IT is stated in the *Journal* of the American Medical Association that, at a recent meeting of the international committee awarding prizes for the best works on rheumatism at Moscow, Professor Intvar, of Lund, Sweden, Professor van Breemen, of the Netherlands, Professor Maximilian P. Conchalovsky and Professor G. M. Danichevsky, of Moscow, were present. Forty-two scientific works were reviewed. The prize of $10,000 was divided in equal parts among Professor Calnietere, of Stockholm; P. Wayle, of Paris; Schlesinger, of London, and Freinhed, of Vienna.

THE thousand dollar prize of the *Readers Digest* has been awarded to Dr. Wilton Marion Krogman, asso-

ciate professor of anthropology of the School of Medicine of Western Reserve University. The title of the article for which the prize was awarded is "The Skeleton Speaks." It gives a popular account of some of his medico-legal interpretations of crime.

UPON his retirement from the deanship of the Graduate College of the State University of Iowa, which he has held for twenty-eight years, Professor Carl E. Seashore has been made dean emeritus. He is succeeded in the deanship by Dr. George D. Stoddard, professor of psychology and director of the Child Welfare Research Station. Professor Seashore will continue to devote his time to the direction of research in the department of psychology.

PROFESSOR EDWARD SAMPSON has at his request been retired as chairman of the department of geology at Princeton University, in order that he may have more time to devote to research. Professor A. F. Buddington has assumed the chairmanship of the department, and Newton E. Chute has been appointed instructor in economic geology.

DR. CARL MURCHISON has resigned from a professorship of psychology at Clark University. He will devote his time to the editing of the five psychological journals now published under his direction. He can be addressed at The Journal Press, Provincetown, Mass.

DR. JOHN WILLIAM MCNEE, formerly associate professor of medicine and associate physician at the Johns Hopkins University and Hospital, has been appointed regius professor of the practice of medicine at the University of Glasgow, in the place of Professor T. K. Monroe, who recently resigned.

DR. ELDRIDGE L. ELIASON, until recently professor of clinical surgery at the School of Medicine of the University of Pennsylvania, has been appointed John Rhea Barton professor of surgery. He succeeds the late Dr. Charles H. Frazier, of whom he was a former student. Dr. Eliason was appointed assistant instructor in surgery in the medical school in 1907.

DR. P. W. WHITING has been appointed associate professor of zoology at the University of Pennsylvania. He will have charge of the work in genetics.

DR. WARREN N. KECK, of the University of North Dakota, has been appointed instructor in biology at Coe College, Cedar Rapids, Iowa.

THE Ramsay Memorial Fellowship Trustees have made the following awards for the year 1936–37 at University College, London: Dr. E. D. Hughes, British fellowship of £300, tenable for two years; R. R. Gordon, Glasgow fellowship of £300, tenable for two years; Dr. Daniel Porret, Swiss fellowship of £300. The following fellowships have been renewed: Dr. N. Ando, Japanese fellow, University College, and C. S. Lees, British fellow, and Dr. D. MacGillavry, Netherland fellow, both of the University of Cambridge.

DR. HAROLD THOMPSON, of Newfoundland, has been given charge of fishery investigations under the British Department of Scientific and Industrial Research, which is providing £80,000 over five years, including the cost of a deep-sea trawler. The possibility of using non-edible fish as fish-meal, methods of quick freezing and the canning of edible fish will be investigated.

DR. ALFRED GILMAN, assistant professor of pharmacology and toxicology at Yale University, has been awarded a research grant from the Committee on Scientific Research of the American Medical Association. The grant will be applied to a study of the physiology of the antidiuretic hormone of the posterior pituitary gland. A report describing the nature of the problem and preliminary results was published in the issue of SCIENCE for July 3, 1936.

IN the report in SCIENCE of the awards made by the academies of the southeastern United States, it was stated that an award of $25 had been made to Dr. Frederick W. Kinard. This award was made jointly to Dr. Kinard and Dr. Foster N. Martin, Jr., of the South Carolina Academy of Science, for a paper entitled "A Study of Blood Histamine in Normal and in Burned Dogs."

DR. FRANKLIN HOLLANDER, until recently of the School of Dentistry of Columbia University, has been appointed fellow in gastro-enterology research at the Mt. Sinai Hospital, New York City, where he will continue his work on the chemical physiology of the digestive tract.

THE State Board of Control of Florida has announced the appointment at the University of Florida of Percy W. Frazer, of the U. S. Forest Service, Baldwin, Mich., to the fellowship in forestry in the department of chemistry for the study of "Some Phases of the Cellulose and Naval Stores Industry of the South," and the appointment of James W. Miller, Jr., from the U. S. Timber Type Survey, Chipley, to the fellowship in the department of botany, to study "The Ecology of the Slash Pine." The department of forestry at the university has recently acquired title to 1,500 acres of forest lands in the vicinity of the university.

O. T. KREUSSER, for the last five years director of the Museum of Science and Industry, Chicago, resigned on October 1 to become a member of the research staff of the General Motors Corporation.

ROBERT T. ORR, of San Francisco, recently of the U. S. National Park Service, has been appointed assistant curator in the department of ornithology and mammalogy of the California Academy of Sciences, to fill the position left vacant by the recent resignation of Mrs. M. E. Davidson.

DR. ALEXIS CARREL, member of the Rockefeller Institute for Medical Research, arrived in New York on September 28, after having spent the summer in Europe.

PROFESSOR HERMANN WEYL, of the Institute for Advanced Study, who has been in Europe during the summer, has returned to Princeton.

PROFESSOR HANS FISCHER, of the University of Munich, recently visited the C. F. Kettering Foundation for the Study of Chlorophyll and Photosynthesis at Antioch College.

DR. CHARLES ZELENY, professor of zoology at the University of Illinois, on account of ill health has leave of absence for the first semester of this year. His work as head of the department is being carried on by a committee of three of its members.

JOSEPH R. SLEVIN, curator of herpetology at the California Academy of Sciences, left for Australia on September 5. He will collect reptiles and amphibians in various parts of eastern Australia during the next five months for the academy, supplementing previous collections made by him in the same region and in western Australia.

DR. PAUL DUDLEY WHITE, assistant professor of medicine at the Harvard Medical School, will deliver the principal address at the observance of Ether Day at the Massachusetts General Hospital on October 16. On this occasion there will be a buffet luncheon, followed by a scientific program.

THE United States Civil Service Commission announces open competitive examinations for the positions of principal fuel technologist, $5,600 a year; senior fuel technologist, $4,600 a year, and fuel technologist, $3,800 a year. Vacancies in these positions in Washington, D. C., and in the field, and in positions requiring similar qualifications will be filled from these examinations, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. The salaries named above are subject to a deduction of 3½ per cent. toward a retirement annuity. At present there are vacancies in these positions in the Bureau of Mines, Department of the Interior, with headquarters at the Pittsburgh Experiment Station, Pittsburgh, Pa., which will be filled as a result of these examinations. The duties incumbent on these positions are: To administer, direct, plan or conduct research in fuel and coal technology at the Pittsburgh Experiment Station of the Bureau of Mines at Pittsburgh, Pa.; and to consult and advise on scientific, engineering and development problems at other bureau stations and in the field, relating to the preparation, processing and utilization of coal and coal products. Competitors will not be required to report for examination at any place, but will be rated on their education and experience on a scale of 100, such ratings being based upon competitors' sworn statements in their applications and upon corroborative evidence. Applications must be on file with the United States Civil Service Commission at Washington, D. C., not later than October 26, 1936.

THE third International Congress on Malaria, which was to have been held in Madrid from October 12 to 18, has been postponed on account of the present situation in Spain. It is hoped to hold the congress some time during the spring or summer of 1937. Dr. E. Luengo, Madrid, is general secretary.

THE fourth International Conference of Agricultural Economists was held at the University of St. Andrews during the first week of October. The first conference was held at Dartington Hall, Devon, the second at Cornell University and the third in Germany. L. K. Elmhirst, of Dartington Hall, presided. The opening paper was by Professor W. R. Scott, of Glasgow, on "The Relation of Agriculture to Industry and the Community." Other discussions were on "The Relation of Land Tenure to the Economic and Social Development of Agriculture," "Farm Organization, with Special Reference to the Need of the Technical, Industrial and Economic Development of Agriculture" and "The Problems of Consumption of Agricultural Produce." There were also papers on land tenure research, part-time farms for industrial workers, agricultural credit, milk marketing and international trade policy.

THE forty-seventh annual meeting of the Association of American Medical Colleges will be held in Atlanta, Ga., from October 26 to 28.

THE Association of Land Grant Colleges and Universities will hold its annual meeting at Houston, Texas, on November 16, 17 and 18, under the presidency of Dr. J. G. Lipman, of Rutgers University.

THE twenty-first annual meeting of the Optical Society of America will be held at the Hotel Pennsylvania, New York, N. Y., from October 29 to 31. This meeting is a joint one with the other founder societies of the American Institute of Physics, and a special program has been prepared which includes symposia as follows: *Training of Physicists for Industrial Positions,* sponsored by the American Asso-

ciation of Physics Teachers, the speakers being Dean Homer L. Dodge, University of Oklahoma, and Dr. A. R. Olpin, Kendall Mills. *Physics in Industry,* Dr. E. C. Sullivan, Corning Glass Works; Dr. Zay Jeffries, General Electric Company; Dr. Paul D. Foote, Gulf Research and Development Company; Dr. J. P. Den Hartog, Harvard University; John Ely Burchard, Bemis Industries, Inc.; E. O. Buckley, Bell Telephone Laboratories; Dr. Clark B. Millikan, California Institute of Technology, and Joseph Slepian, Westinghouse Electric and Manufacturing Company. *The Applications of Optics in Modern Science,* Dr. Saul Dushman, General Electric Research Laboratory; Professor E. R. Schwarz, Massachusetts Institute of Technology, and Dr. Magnus Gregersen, University of Maryland. On Friday evening there will be a joint dinner of all the founder societies.

A SERIES of lectures in industrial chemistry and chemical engineering will be presented by specialists of the Mellon Institute of Industrial Research, Pittsburgh, during 1936–37. The course opened on October 1. These discourses, which will be delivered on alternate Thursdays, at 11:30 to 12:30 throughout both semesters, will be open to all students of industrial chemistry and chemical engineering in the University of Pittsburgh as well as to members of the institute. The lecturers and their subjects follow: Dr. E. R. Weidlein, "The American Chemical Industries and Their Problems"; R. H. Heilman, "Heat-Insulating Materials"; Dr. T. A. Wilson, "Radiations and Their Utility in the Industries"; Dr. F. W. Adams, "Recent Progress in the Production of Heavy Chemicals"; Dr. G. J. Bair, "Silicon Compounds"; Dr. F. J. Williams, "Barium Products"; D. G. Bennett, "Sanitary Enamels"; Dr. E. P. Breakey, "Insecticides and Fungicides"; Dr. E. P. Barrett, "Bone Products"; H. F. Robertson, "Synthetic Organic Chemicals"; Dr. R. L. Wakeman, "Synthetic Resins"; Dr. J. D. Jenkins, "Modern Lacquers"; Dr. W. B. Burnett, "New Textile Products," and Dr. H. K. Salzberg, "Dairy Products and Their Markets."

FRANCIS H. ALLEN, chairman of the directors of the Massachusetts Audubon Society and vice-president of the Federation of the Bird Clubs of New England, writes: "The account in SCIENCE of October 2 of the recent merger of the Federation of the Bird Clubs of New England with the Massachusetts Audubon Society needs a little emendation. It should be made clear that the Federation goes out of existence and that the Audubon Society takes over certain important properties, but continues under its present name, with Mr. Buchheister succeeding Mr. Packard as its secretary-treasurer and executive officer. Of the eleven reservations enumerated, only two—the Annie H. Brown Wild Life Sanctuary on Plum Island and Tern Island, off Chatham, Massachusetts—become the property of the Audubon Society, the others having been previously given to the State of Massachusetts in accordance with the purpose for which they were acquired."

DISCUSSION

NEW RACIAL BLOOD GROUP STUDIES IN EUROPE AND EGYPT

DURING the year 1935–1936, the authors carried out studies on the frequencies of the Landsteiner blood groups and the newer M and N groups of Landsteiner and Levine. The opportunity was taken to observe also the frequency of certain other hereditary factors, such as the ability to taste phenyl-thio-carbamide.[1] Work was carried out in Cairo, Kharkov, Tiflis, Zagorsk (near Moscow), 5 Welsh towns (Llangefni, Caernarvon, Bangor, Machynlleth, Tregaron), Dublin, San Sebastián and Assiut. So far as the authors are aware, no work on the Landsteiner groups has been published from any of these places except the first three, data on M and N have appeared only from the first and data on "taste blindness" only from the last. The most interesting results obtained would seem to be the following.

Two places were found where the percentage of N is significantly lower than the rather consistent figures thus far obtained for Europe (Zagorsk and Tiflis). It will be recalled that the only previous instance of this was furnished by the North American Indians.[2]

Contrary to what might have been expected, no significant difference in blood group frequencies was found between the Copts and Mohammedans in Egypt. In Assiut, the percentage of B was definitely higher than in Cairo (30.5 *vs.* 25.3).

The blood group formula of the Basques (San Sebastián), apparently similar to that of the Australian aborigines and certain American Indians, is probably 0 = ca. 60 per cent., A = ca. 40 per cent. (actually found: Basques—0 = 56.0, A = 40.5, B, 1.3, AB, 2.2; non-Basques—0, 45.9, A, 46.5, B, 5.0, AB, 2.6. The small amount of B found might be readily ascribed to mixture with non-Basques.

[1] L. W. Parr, *Jour. Hered.*, 25: 187, 1934.

[2] A. S. Wiener, "Blood Groups and Blood Transfusions," pp. 132 and 169. Springfield: Charles C Thomas, 1935.

A rather low percentage of "tasters" was observed in Wales (for men, 46.7). Confirming the observations of Fisher and Brandt,[3] a sex difference, in most cases definitely significant statistically, was observed in the tasting results. The ratio of the percentage of female to the percentage of male tasters varied from 1.56 to 1.02.

In addition data were collected on about 200 sibs, which will be analyzed for evidence of linkage,[4] and more than 100 specimens of mummy tissue were obtained, in order to study, if possible, the blood groups of the ancient Egyptians.[5]

Details will be published elsewhere.

William C. Boyd,
John Simon Guggenheim Memorial fellow, 1935–36
Lyle G. Boyd

Evans Memorial Hospital
Boston University School of Medicine

FURTHER OBSERVATIONS ON PARASITISM IN THE STARFISH[1]

During the summer of 1936 studies were continued at Milford Laboratory of the Bureau of Fisheries on *Orchitophrya stellarum* Cépède, a gonad parasite of *Asterias forbesi*. Although this parasite is found generally in males, it occurs occasionally in females. Of 326 males examined microscopically, 43 (or 13.2 per cent.) contained *Orchitophrya*, whereas only 4 (or 1.1 per cent.) of the 382 females were parasitized. The incidence of parasitism in this species is much lower than that found by Smith[2] in *A. vulgaris* and much higher than that found by Cépède[3] in *A. rubens*. In Long Island Sound the percentage of parasitized males varies according to the locality, being as high as about 20 per cent. in the region of Stratford Point and as low as about 1 per cent. around New Haven.

Parasites within the egg membrane have not been found yet in sectioned ovaries, but in eggs extruded from the living gonad this is common. The parasites can be seen moving around in the yolk and upon complete destruction of the yolk, the ciliates swim freely within the membrane, apparently unable to get out. Both division and conjugation are frequently seen in the living parasites.

The degree of parasitism varies within the individual. Although generally a starfish is completely parasitized, there are cases in which some gonads of the same individual are infested and others not, or some heavily infested and others only slightly parasitized. A parasitized ovary is usually purplish in color, rather than orange or yellow as in normal ovaries, yet this is not a definite indication of the presence of *Orchitophrya*. A deteriorating ovary, due to unfavorable environmental conditions, such as lowered salinity, may also show a purplish color. An infested testis is generally brownish or dirty white in color, whereas the normal color is whitish or pale yellow.

Piatt[4] obtained negative results in his attempts to parasitize starfish. In the present studies additional experiments have been carried out for both direct and indirect parasitism. Indirect infection was attempted in the following experiments: young *Mytilus edulis* and *Mya arenaria* were placed in separate finger bowls of parasitized sperm suspension and left until the solution was clear. The animals were later examined at intervals of several days, but in no case could the parasite be found in the mussel or clam and apparently served only as food. For attempts at direct infection some heavily parasitized sperm suspension was added to finger bowls containing: unfertilized eggs, cleavage stages, blastula, gastrula, stomadeum and recently metamorphosed starfishes. Negative results were obtained in all but the gastrula stage.

Nearly all the gastrulae became parasitized by one or several *Orchitophrya*. These move freely within the body cavity of the larvae as development proceeds After the stomadeum breaks through, the parasites are shut off from the outside. The parasitized larvae, however, appear to lag somewhat behind the normal ones in development. Unfortunately, all larvae, controls as well as parasitized ones, died before reaching the Bipinnaria and metamorphosing stages. *Orchitophrya* that enter the larvae after the stomadeum opens soon die in the stomach and serve as food. Fifty-one young starfish collected near Stratford Point, Conn., where the incidence of parasitism in adult animals is high, failed to show a single *Orchitophrya*.

The fact that no parasites were found in recently metamorphosed starfish taken from a region where parasitism is common and the fact that infected larvae develop more slowly than normal ones may indicate that all parasitized larvae die before metamorphosis and that the parasite does not remain quiescent until maturity. If such is the case, the method of parasitism in the adult starfish is yet to be discovered.

Robert B. Burrows

Milford (Conn.) Laboratory
U. S. Bureau of Fisheries

[3] R. A. Fisher and A. E. Brandt, personal communication.

[4] L. S. Penrose, *Ann. Eugen.*, 6: 133, 1935.

[5] Wm. C. Boyd and L. G. Boyd, Science, 78: 578, 1933; *Proc. Soc. Exp. Biol. and Med.*, 31: 671, 1934.

[1] Published by permission of the U. S. Commissioner of Fisheries.

[2] G. F. M. Smith, Science, n. s., 84: 157, 1936.

[3] C. Cépède, *Arch. Zool. Exp. et Gen.*, Ser. 5, 3: 341, 1910.

[4] J. Piatt, *Fisheries Service Bull.*, No. 247, p. 3, U. S. Dept. of Commerce, 1935.

MULTIPLE PINE SEEDLINGS

THE occurrence of two well-developed seedlings from the same seed seems to be very rare in pines.[1,2]

A list of instances of multiple seedlings among pines may be of interest to which similar observations may be added.

Observer	Species	Instance
Toumey[3] (1923)	*Pinus thunbergii*	1
Jacobs[4] (1925)	*P. lambertiana*	12
Clare[2] and Johnstone (1931)	*P. torreyana*	2
	P. sabiniana	2
	P. cembroides var. *monophylla*	2
Moskedal[5] and Johnstone (1936)	*P. coulteri*	1
	P. jeffreyi	6
	P. lambertiana	2
	P. monticola	3
	P. muricata	1

All the above observations have been made by the several observers incidental to seed germination tests.

G. R. JOHNSTONE
UNIVERSITY OF SOUTHERN CALIFORNIA

SCIENTIFIC BOOKS

THE NATURALISTS

Green Laurels. The Lives and Achievements of the Great Naturalists. By DONALD CULROSS PEATTIE. New York: Simon and Schuster, 1936; 368 pp., 32 illustrations.

FIVE or six years ago there was published a most interesting book by Bernard Jaffe, entitled "Crucibles." In the course of 378 pages it described, in the most lively fashion, the lives and labors of about sixteen of the greatest workers in chemistry and physics, beginning with Trevisan (1406–1490), and ending with modern workers, in some cases (as J. J. Thomson) still living. It was shown how the beginnings of chemistry were apparently sterile, devoted to efforts which wasted lives and money, and led to no tangible results. Yet out of all this there emerged, gradually, an understanding of natural laws, and through the efforts of keen minds, modern science took form and led to the amazing discoveries and inventions with which we are all familiar. Although the names selected represent only a very small percentage of the efficient workers, it is true that the great steps in advance were due to very few men, who often had to struggle for recognition. There was in fact a double struggle; first, that within the man, to develop his ideas and come to an understanding with himself, and then the difficult task of making others see with his vision. Such a book telling such a story represents the best type of historical writing, capable of inspiring respect for the achievements of the past and hope for those of the future.

This success having been attained, it must have occurred to many that other fields of intellectual effort were equally worthy of such elucidation. Peattie has chosen to take the naturalists, and a better choice could not have been made. Chemistry and physics are great, we feel for them the utmost respect, perhaps we should say reverence; but it is for living things that we have affection, life is above and beyond all the marvels of inanimate nature. The new book might have been about the people known as biologists; the wonders of embryology, physiology, genetics and all those things which belong to the laboratories and experimental gardens. There is plenty of material for such a work, and perhaps our author will undertake it at some later date. But we are now concerned with those who were intimate with nature in her own home, who visited her and took delight in the contemplation of her diversity and beauty. Their attitude was emotional as well as intellectual, calling forth the whole range of human faculties. Through an understanding of their work, we sense the richness of life on the globe, the pageant which is continually passing before our too unobserving eyes. Thus the book is at once a story of romance and an invitation to a feast. The events narrated run more or less parallel with those of chemistry. The early workers struggled with confused ideas, but nevertheless made progress. The great variety of living things came to be appreciated as the world was explored, and as the invention of the microscope revealed the thousands of minute creatures, invisible to the naked eye. The chapter "Science at Court" shows us the time of Louis XV in France, when Buffon and Réaumur were rivals, and tells how Réaumur died, leaving manuscripts which were declared by the great Cuvier to be worthless. They might have been lost forever, but for the fact that W. M. Wheeler, visiting Paris in 1925, had the curiosity to look them up. He found that they included many careful and accurate observations on ants, and three years later published a translation. There are two excellent chapters on Linnaeus, followed by a chapter on "Glories and Follies of the Linnaean Age." The seventh chapter deals with Lamarck, whom the author regards very highly, and then we come to a discussion of "Anatomist against Dreamer: Cuvier and Lamarck." It concludes thus:

"It would be a blow, too, for Cuvier if he could see where Lamarck stands to-day. Cuvier, who knew a thousand facts, was the author of the worst theory of the history of life that was ever suggested by a great scientist. The true explanation—or the most nearly

[1] Schnarf, "Handbuch der Pflanzenanatomie." Lief. 30 (Band X_2). S. 211. 1933.

[2] Clare and Johnstone, *Amer. Jour. Bot.* 18: 674–83, 1931.

[3] Toumey, *Bot. Gaz.*, 76: 426, 1923.

[4] Jacobs, *Jour. Forestry*, 22: 573–574, 1925.

[5] Moskedal and Johnstone. To be published.

true—began with Lamarck as an intuition, became a conviction, and, unsupported by proofs such as we could give to-day, went down in apparent defeat. No one fails so completely as a genius" (p. 185).

Leaving Europe, we now come to chapters on the early American naturalists; Bartram and Michaux, the botanists; Wilson and Audubon, the ornithologists; Say and Lesueur, and that singular character Rafinesque. There is then an account of Goethe and the Romanticists, a quite full account of Darwin and Wallace and a final chapter on Fabre. Agassiz is omitted, "because most of what he stood for in natural history had already been expressed by Cuvier."

It is a charming book, certain to do a great deal of good. There should, however, be a somewhat revised edition. Peattie's emotional impulse, the very intensity of his convictions, sometimes leads him astray. He seems like a man on a splendid horse, riding in hot haste to a certain goal, sometimes careless of what is trampled under foot on the way. Thus (p. 298) "For the East Indies are the isles of five times ten thousand beetles, the country of the gorilla, the archipelago of birds of paradise, each species with an island to itself." Or (p. 292) "It was the 'Brownian Movement,' the spontaneous streaming of protoplasm, as disturbing for human eyes to see as the procession of the suns of space across a telescopic field, and fraught, as much, with human destiny." Or (p. 318) "But Father Gregor, superior of an Austrian monastery, was working his marvelous sweet-pea plot all unknown to the world of science." Some of the statements about Rafinesque are fantastically extravagant: "Amongst all the naturalists who have ever worked on the American continent, Rafinesque is the only one who might clearly be called a titan" (p. 263). "If the rules of priority were strictly and justly applied, Rafinesque would be found to have antedated a large part of the work of Say amongst shells, of his enemy Harlan amongst mammals, in botany of Gray and De Candolle." (p. 266.) A curious point has to do with "the deep roar of the gorilla" (p. 164). This appears to be traditional,[1] but last year I spent considerable time watching the two gorillas (the mountain form, from the region near Lake Kivu) in the zoological gardens at San Diego. They are in robust health, and play together a great deal, running and wrestling. They make a noise by beating the chest, clapping the hands and beating rapidly on an iron door. They seem not to be vocal at all, under ordinary circumstances, but Mr. B. J. Benchley, the superintendent, tells me that they will occasionally utter a sort of scream under stress. They were tested with different kinds of music, and it was found that they were interested in anything of the nature of a drum, but wind or string instruments had no meaning for them. They pay no attention to the gibbon in the next cage, which sits on its perch and cries like a lost soul, just as I heard the gibbons crying in the tree-tops at dawn in Siam.

The illustrations in Peattie's book are of necessity those already familiar elsewhere, but they are well chosen and most excellently reproduced.

It is interesting to think how the historian, after many years, can perceive the significance or interest of events which could not be so understood when they happened. Peattie gives a figure of the Franklinia, a beautiful plant related to the camellia, discovered by Bartram in Georgia in the latter part of the eighteenth century. It still exists in cultivation, but how was Bartram to know that he had found the last wild specimen of a species on the point of extinction, a species which, but for him, would never have been known to man? When Say, in the far west, found the oval striped beetle which we call *Leptinotarsa decemlineata* (Say), he could not tell that eventually it would be known as a major pest of potatoes and related plants, of tremendous importance to mankind. It is for the historian to relate the present to the past, and so far as the naturalists are concerned, work of the type of Peattie's can be extended almost indefinitely.

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[1] See, for instance, Flower and Lydekker, "Introduction to the Study of Mammals," p. 736.

SPECIAL ARTICLES

THE REGENERATION OF VISUAL PURPLE IN SOLUTION

In 1878 Kühne[1] reported that visual purple in solution, after being bleached by light, will regenerate some of its color in the dark. To our knowledge this observation has never been confirmed, though it is commonly known that most investigators concerned with visual purple have vainly tried to repeat it. In fact, many of the published measurements with visual purple depend on the fact that a bleached solution remains constant and does not change in color. We wish to report that not only have we been able to confirm Kühne's observation, but that we have learned to specify some of the conditions controlling the regeneration of visual purple *in vitro*, and have measured its kinetics; and in addition have critically established the

[1] A. Ewald and W. Kühne, *Untersuchungen aus dem physiologischen Institut der Universität Heidelberg*, 1: 267, 1878.

phenomenon by measuring the absorption spectrum of the newly formed visual purple.

A visual purple solution, freshly prepared from frogs, is pinkish purple. When exposed to strong light, the color changes rapidly to yellow and then very slowly to colorless. If the bleached yellow solution is placed in the dark at 25° C. and examined an hour later, it is found to be distinctly pinkish again, and this color fades rapidly on exposure to light. This procedure may be repeated several times and is what Kühne described.

We have measured the course of regeneration in the solution by following its photometric density at 500 mμ with a highly sensitive photoelectric spectrophotometer which uses so little light that it leaves the visual purple unaffected. Regeneration begins immediately and proceeds rapidly; more than half the increase in density is accomplished in the first 10 minutes, though the density continues to increase for over an hour, reaching asymptotically a concentration about 15 per cent. of the original solution. The curve of density against time resembles the usual kinetics of chemical reactions.

Reformation of visual purple is demonstrable by this means only when the bleaching by light has reduced the visual purple to below 15 per cent. of its original concentration. If the bleached concentration is much higher, the density continues to decrease in the dark. At between 15 to 20 per cent. of the original concentration, the density hardly changes at all in the dark. Evidently after bleaching, two processes take place in the dark: one concerned with forming visual purple from its decomposition products, the other with the further changes of the decomposition products.

The regeneration of visual purple takes place only in relatively fresh solutions made either with bile salts or with digitalin crystals (Eimer and Amend), and in a narrow range of pH. Above pH 8.0 the effect is negligible, while below pH 6.6 the results are uncertain and are complicated by the presence of a decomposition product of visual purple which is yellow at acid pH's[2] and which fades in the dark.[3]

The fact that regeneration takes place only to a slight extent beyond pH 8.0 enables us to measure the absorption spectrum of the freshly formed visual purple. A visual purple solution buffered to pH 7.6 is divided into two equal samples A and B. Both are exposed to the same bright light for 10 minutes, which bleaches them almost completely. To sample A NaOH is added to make its pH 10.5. The two samples are then placed in the dark. Sample B, being at pH 7.6, regenerates noticeably, while sample A, being alkaline, regenerates only slightly if at all. After an hour in the dark, NaOH is added to sample B to make its pH also 10.5. The absorption spectrum of both samples is then measured. Any difference between the two samples represents the regenerated visual purple.

There are two criteria for recognizing visual purple. One is its absorption spectrum,[4] which in the case of frog visual purple is a nearly symmetrical curve with a maximum at about 500 mμ. In Fig. 1 the open

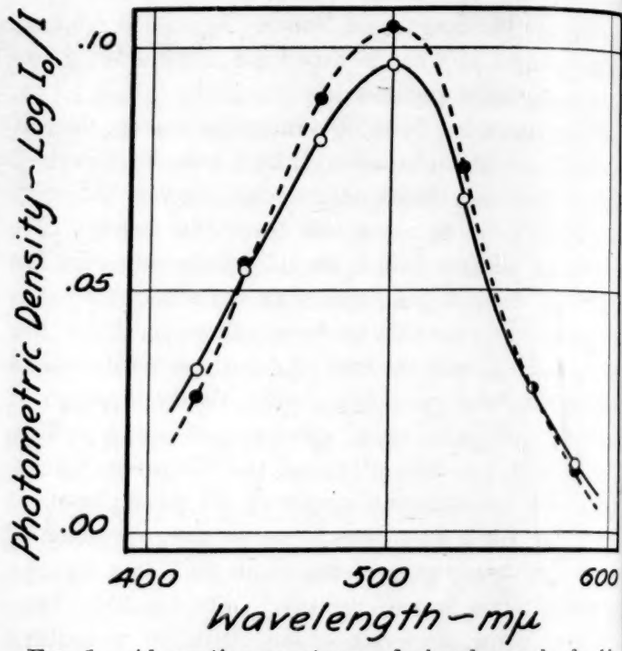

FIG. 1. Absorption spectrum of visual purple freshly formed in solution from its photochemical products.

circles represent the difference between the absorption spectrum of sample A which had remained at pH 10.5 in the dark, and the absorption spectrum of sample B which had been at pH 7.6 in the dark, and in which regeneration had occurred. It is apparent that the difference between the two solutions represents a substance with a nearly symmetrical absorption spectrum whose maximum is at about 500 mμ.

The second criterion for recognizing visual purple is its sensitivity to light. If sample B (now at pH 10.5) is exposed to strong light for 10 minutes, it is rapidly bleached. An indication of the amount of material which has disappeared on bleaching is the difference in absorption spectrum of sample B before and after bleaching. These values are the solid circles in Fig. 1. It is apparent that within the errors of an experiment of this nature, the concentration and the absorption spectrum of the material removed by bleaching are practically identical with the concentration and absorption spectrum of the material freshly formed during the stay of sample B in the dark. There can therefore be no doubt that under the proper

[2] A. M. Chase, *Jour. Gen. Physiol.*, 19: 577, 1936.
[3] Y. Hosoya, *Arch. ges. Physiol.*, 233: 57, 1933.
[4] E. Köttgen and G. Abelsdorff, *Zeit. Psychol. u. Physiol. d. Sinnesorgane*, 12: 161, 1896.

conditions visual purple can be formed again in solution from its products of decomposition by light.

For the record we give the essential details for the preparation of visual purple solutions used in these experiments. Freshly caught, summer (1936) frogs (*R. pipiens*) from Alburg, Vermont, were dark adapted over night. Their heads were cut off in the light of a 10 watt ruby lamp, and the eyes removed and cut in half just back of the iris. The parts containing the retinas were left in a 4 per cent. alum solution for 2½ to 3 hours at 25° C., after which the retinas were removed as free of pigment as possible and washed once with 0.04 *M* borate-KCl buffer of pH 9.3 and three times with water by decantation. Finally, the excess water was removed by centrifugation. A 4 per cent. solution of purified bile salts was next added in the proportion of 1 ml of solution to 27 retinas, and the mixture gently stirred for 10 minutes at 30° C. The suspension was then centrifuged at a high speed for 1½ hours at 5° C., and the clear, supernatant liquid removed and stored in the dark at 0° C. For bleaching the solutions, we used a 100 watt lamp at 25 cm distance with a heat-absorbing glass interposed, and a mirror backing the solution. The particular experiment shown in Fig. 1 began with 3 ml of solution to which was added 1 ml of 0.4 *M* phosphate buffer of pH 7.6; the colorless precipitate which formed was allowed to settle and then filtered off, and the filtrate containing the visual purple was divided into samples A and B, each placed in a 5 mm cell for absorption measurements. After bleaching, one drop of 1 *N* NaOH was added to change the pH to 10.5; this caused a colorless precipitate to form, which was allowed to settle to the bottom of the cell before the absorption spectrum of the solution was measured. The pH measurements were made with a glass electrode.

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PROTEIN COAGULATION AS A RESULT OF FERTILIZATION

DURING the past two years I have developed a technique for studying the proteins of the sea-urchin egg and have found that a pronounced change in state of the proteins in the egg takes place soon after fertilization. Experiments on the quantities of soluble protein in unfertilized and fertilized eggs of the sea-urchin (*Arbacia punctulata* at Woods Hole, Mass., and *Strongylocentrotus purpuratus* at Corona del Mar, Calif.) show that about 12 per cent. of the total protein in the cell becomes insoluble as a consequence of fertilization. The protein fraction in which the change occurs has been identified, and some of the properties of this protein have been investigated. The time-course of the change has been followed, beginning at three minutes after insemination and ending two hours later, when the egg is in the two-cell stage. As a result of these experiments, the significance of the change in state of protein for the egg can perhaps be understood.

To investigate the protein contents of the egg the first need is to disrupt the cell by a method that does not involve the use of reagents known to alter proteins. I have found that both fertilized and unfertilized eggs can be disintegrated by freezing in a solid carbon dioxide-ether mixture at −77° C., drying in a vacuum at about −25° C., and then grinding the powder so obtained. Scarcely an intact cell remains after this treatment. The disintegrated cell material is extracted with a large volume of cold 1 M KCl solution at a pH of about 7.3. Under these conditions between 82 and 85 per cent. of the total protein of unfertilized eggs goes into solution, whereas only 69 to 72 per cent. of the protein of fertilized eggs dissolves.

Some of the reasons for the technique developed may be briefly given. Freezing and thawing suffice to disintegrate unfertilized eggs; this procedure, however, kills fertilized eggs, but it does not break them; hence the need for the drying and grinding procedure. The instability of the protein system in the cell also presents difficulties. If eggs are frozen and then allowed to thaw, it is found, after subsequent drying and grinding, that in both unfertilized and fertilized eggs only about 50 per cent. of the total protein is soluble. And if the protein fraction that becomes insoluble during fertilization is isolated from unfertilized eggs and then frozen in the same way as were the eggs from which it was prepared, this protein becomes insoluble, whereas it remains soluble when the intact egg is frozen. Once these properties of the material have been recognized, however, it is not difficult to estimate with accuracy the relative quantities of soluble and insoluble protein in a mass of eggs.

The protein that coagulates during fertilization can be prepared from unfertilized eggs by freezing, drying, extraction with potassium chloride and precipitation by ammonium sulfate, this protein being in the fraction first salted-out. The protein can be freed from many other cell constituents by repeated reprecipitation, but it is not claimed that a single protein has been isolated. In solution at a pH of about 7.0 the protein particles appear to be exceedingly elongated, for the solution possesses high viscosity (a 1.4 per cent. solution is 9.6 times as viscous as water),

and the relative viscosity, measured in an Ostwald viscosimeter, decreases when pressure is applied. Furthermore, the solution shows double refraction of flow.[1]

I have found by investigating protein sulfhydryl and disulfide groups that when coagulation occurs in the cell the change in protein is distinctly different from that caused by the usual protein denaturing agents—heat, acid, etc. When these agents coagulate proteins, changes in their sulfhydryl and disulfide groups are observed;[2] whereas, when coagulation takes place in the cell, no change in these groups is detectable, although a change is observed if the proteins of the egg are treated with acid. In this respect coagulation in the egg resembles the coagulation of myosin as it occurs in the contraction and rigor of muscle.[3] Of all the known ways of coagulating myosin *in vitro* only in dehydration (either by drying or freezing) is loss of solubility *not* accompanied by a change in sulfhydryl groups.[4] In this kind of coagulation it would appear that when the shell of water enveloping a protein particle is removed the outer groups of the particle become firmly attached to the outer groups of other particles. An insoluble mass of protein is formed with far less disturbance of the inner configuration of the molecule than when coagulation is caused by any of the usual denaturing agents.[5] The type of coagulation that takes place in muscle and in the egg is of the type observed in dehydrated myosin. It should be noted that the protein in the egg which coagulates during fertilization readily coagulates if, when isolated, it is dehydrated.

The time-course of protein coagulation after fertilization shows that the protein change is not associated either with elevation of the fertilization membrane or with the cycle of cell-division that follows fertilization. The fertilization membrane is formed within a minute after insemination; coagulation begins about three minutes later and is completed within the next ten minutes. No change in the quantity of coagulated protein is detected during the next two hours, during which time the egg passes through a complete mitotic cycle. Coagulation is, however, associated with another change in structure of the egg, an increase in strength and elasticity. The unfertilized egg is broken by freezing and thawing, whereas the fertilized egg is not broken by this treatment. The increase in strength manifested in this way is not due to presence of the fertilization membrane, for even after it has formed the cell is still fragile. Increased strength of the cell appears within the ten minutes following membrane elevation, during the time of protein coagulation. And the ability of the cell to withstand freezing and thawing remains thereafter (at least for two hours) just as the coagulated state remains. The explanation of this increase in strength and elasticity is that in coagulation the elongated protein particles unite to form a fibrous net-work. This, an early step in development of the egg, may be regarded as a skeleton framework within which differentiation proceeds.

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[1] A. L. v. Muralt and J. T. Edsall, *Jour. Biol. Chem.*, 89: 315, 351, 1931; G. Boehm and R. Signer, *Helv. chim. Acta*, 14: 1370, 1931.

[2] A. E. Mirsky and M. L. Anson, *Jour. Gen. Physiol.*, 19: 439, 1935–36.

[3] A. E. Mirsky, *Jour. Gen. Physiol.*, 19: 571, 1936.

[4] A. E. Mirsky, unpublished experiments.

[5] A. E. Mirsky and Linus Pauling, *Proc. Nat. Acad. Sci.*, 22: 439, 1936.

THE BERGER RHYTHM IN CATS[1]

THE disappearance of the slower potential fluctuations of about 10 per second in the human electroencephalogram when the eyes are opened was one of the most striking observations reported by Berger in his early papers on the electrical activity of the human brain. This phenomenon has been studied in detail by Adrian and Matthews[2] and by Adrian and Yamagiwa.[3] It is so easy to produce in the average subject that it has now become a commonplace. Kornmueller, who has worked extensively on rabbits, did not report any comparable change in animals. Range,[4] working in the same laboratory, however, has recently published a figure which shows disappearance of the slower potentials in the rabbit with painful stimulation.

Ectors[5] reported that modifications similar to those seen in man are produced by sensory stimulation in the rabbit. The frequency of the slower components, which Berger calls alpha waves, is somewhat slower in the rabbit than in the normal adult human, but, as in the human, they diminish in amplitude or disappear when the eyes are illuminated. Adrian[6] has confirmed this observation on monkeys under light anesthesia.

Work which is now in press,[7] in which one of us had a part, shows a similar effect in the cat. Attention, in the cat as in the rabbit and man, abolishes or dimin-

[1] From the Departments of Physiology and of Neurology, Harvard Medical School.

[2] E. D. Adrian and B. H. C. Matthews, *Brain*, 57: 355–385, 1934.

[3] E. D. Adrian and K. Yamagiwa, *Brain*, 58: 323–351, 1935.

[4] R. W. Range, *Jour. f. Psychol. u. Neurol.*, 6: 365–370, 1935.

[5] L. Ectors, *Compt. rend de la Soc. de biol.*, 120: 1339–1343, 1935.

[6] E. D. Adrian, *Jour. Physiol.*, 87: 1936.

[7] A. J. Derbyshire, B. Rempel, A. Forbes and E. F. Lambert, *Amer. Jour. Physiol.*, 116: 577–596, 1936.

hes the alpha waves. Strong sensory stimulation nder light pentobarbital anesthesia has the same ffect.

We have recently obtained a series of records of

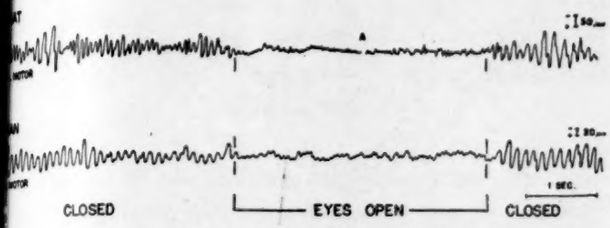

FIG. 1. The effect of opening and closing the eyes on he electrical activity of the cerebral cortex of the cat nd of man. At A six seconds of the cat record was mitted. The record of the cat was made with concentric lectrodes in the sigmoid gyrus; that of man was made ith small metal electrodes cemented on the head, the rid lead over the motor area, and the ground lead on the obe of the ear. Cat not anesthetized during observations.

the change produced by opening and closing the eyes in the cat. As may be seen from Fig. 1, the effect is altogether similar to the effect of the same procedure in man. It is readily obtained from cortical areas far removed from the occipital region, even when, as in this case, concentric electrodes are used. These fluctuations in potential come from immediately under the tip of the electrodes, for if electrodes are allowed to protrude into the ventricle or the subarachnoid space, although the sheath electrode is in contact with as much brain tissue as ever, the fluctuations of potential are no longer obtained.

There is now an accumulation of observations which bridges the gap between the electrical activity of the brain in animals and in man and emphasizes how closely the data on animals and on human material correspond.

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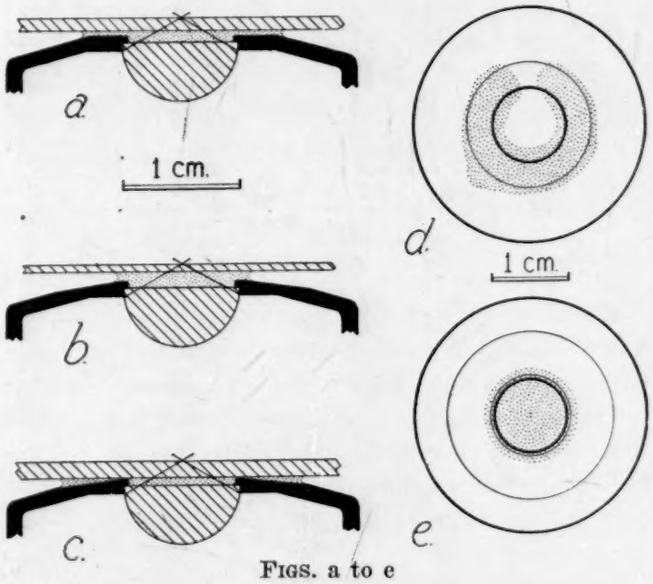
SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN OIL-RETAINING BEVELED FACE FOR HIGH-APERTURE CONDENSERS

FOR critical examinations with the microscope, especially with the highest magnifications, one requisite is that the sub-stage condenser (aplanatic or achromatic) be "immersed," that is, connected to the object slide by a layer of homogeneous immersion oil (refractive index 1.515). To omit this immersion is to limit the condenser to a working numerical aperture of 1.0, although its N.A. may reach 1.40 when properly immersed and focused. The outer rays of the cone delivered by a high-aperture condenser, if not utilized because of an air-gap, are then a source of glare and haze and reduce the contrast and brilliance of the image. Even for low-power objectives, an immersed condenser of aperture corresponding to the objective (or stopped down to that aperture) is best for visual observation and for photography.

One obstacle to the wider use of condenser-immersion is the difficulty of maintaining the connecting layer of oil intact and free from bubbles or air-pockets. This difficulty can be largely overcome by changing the shape of the condenser face. Most high-aperture condensers, as provided by the manufacturers, have a flat face of metal, forming a circular zone of considerable width about the glass of the upper lens (Figs. a, d). This flat face should be converted into a broad cone by filing (or grinding with a carborundum stone) to remove the outer part nearly to the glass of the lens (Figs. b, c, e). The angle of slope seems to be optimal at about 8 degrees, since a slope steeper than about 10 degrees allows the oil to drain away too readily instead of lying in place, while a slope gentler than 5 degrees is not enough to allow free movement of the oil and leeway in focusing range.



FIGS. a to e

In filing the bevel on the condenser face care must be taken to leave intact a ring of metal about half a millimeter in width around the top lens. The upper lens of a condenser is generally crimped into place by an overlapping lip of metal, which also seals the lens against leakage of the immersion oil into the body of the condenser. Leaving this ring maintains the security of the lens mounting and of the seal and also serves the original function of the metal face—that of protecting the lens from being scratched or being forced out of position should the condenser be raised against the slide in focusing.

When a condenser with the original broad flat face

is in use, the oil connection is easily broken by movement of the mechanical stage, instead of traveling freely with it as happens in using the bevel top. Furthermore, any rapid downward movement of the condenser in focusing, often, and under some conditions usually, breaks the film at one side with the sucking in of a large bubble of air which is then trapped above the lens in the pocket formed by the edge of the raised metal face (Fig. d). This trapped bubble can be removed only by making a fresh immersion. When a condenser with an 8 degree oil-retaining bevel is used, racking the condenser downward, in focusing or in using a thin slide, allows the oil to gather in rapidly and uniformly on all sides, making a thicker layer of less diameter (Figs. b, e). The central body of oil can be drawn out to a surprising distance without breaking. On an upward focusing movement the excess of oil merely makes a larger ring of oil about the cone of the condenser top (Fig. c).

It would be well not only to alter the condenser which you are using but also to call the attention of the agent of the microscope manufacturer to this feature whenever he makes his round for orders.

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A SIMPLE METHOD FOR OBTAINING SYNCHRONIZED INDUCTORIUM BREAK SHOCKS

THE short-circuiting device described here was constructed in connection with an apparatus in which it was necessary to synchronize break-shock stimulation of muscle by a Du Bois Reymond inductorium, with the time of exposure of short lengths of photographic film mounted on a revolving kymograph drum. The inductorium was actuated through a relay whose circuit was closed and opened in the usual manner by a contact maker on the axle of the drum. Advantage was then taken of the vertical movements of the horizontal hammer of the inductorium to get only the break shock by the following simple and inexpensive procedure.

The hammer of the inductorium was extended about 5 cm by screwing on to it a light strip of brass. A piece of tough but flexible thread was fixed at the end of this strip and drawn over a light pulley, about 3 cm in diameter, carried on an axle about 10 cm above the inductorium. The free end of the thread was tied onto the head of a 6 penny nail which hung down within a 1 cm diameter glass tube, its lower end dipping into a pool of mercury contained in the tube. One pole of the inductorium secondary was connected by a light flexible electric wire to the nail head; the other pole to the pool of mercury by way of an electrode sealed into the glass tube. Instead of a straight tube of mercury and a sealed-in electrode, a U-tube may be used; the nail then rests in one arm of the tube and the wire from the other secondary pole in the other. A short circuiting key is thus formed across the poles of the secondary. When the inductorium is actuated the arm, moving downward, pulls on the thread and jerks the nail out of contact with the mercury. *If the length of nail originally dipping into the mercury is properly arranged,* contact between mercury and ascending nail will be maintained during generation of the make shock, thus shorting this away from the muscle. At the time of the break shock (in our arrangement, about 0.07 sec. later) the nail is pulled clear of the mercury, and this current can thus flow to the muscle electrodes.

This device, although simple to construct, is quite delicate to adjust properly. Improperly set up, part of the make shock may get to the muscle on the one hand, or, on the other, part of the break shock may be shorted out. The main factor controlling the situation is the length of nail originally dipping into the mercury. Once this is correctly arranged, break shocks automatically synchronized with the movement of the drum can be invariably obtained.

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